Environmental Mission Impact Assessment

J. Ballas,[1] J. Cook,[2] and D. Jones[3]
[1]*Information Technology Division*
[2]*Marine Meteorology Division*
[3]*Applied Physics Laboratory, University of Washington*

Overview: The Environmental Visualization (EVIS) system for producing environmental mission impact assessment products was accepted as a transition in 2007 by the Fleet Numerical Meteorology and Oceanography Center (FNMOC) in Monterey, CA, after passing operational testing and accreditation. EVIS is a service-oriented architecture (SOA) system[1] developed by NRL and the Applied Physics Laboratory, University of Washington, to address human factors and automation issues associated with the stress of the operational tempo. Through a series of experiments, workflow and visualization shortfalls were identified in the battlespace environmental forecasting process. Experimental analysis resulted in the development of new applications, workflows, and visualization products that together constitute the EVIS system. Formal testing demonstrated a 40% reduction in the completion time for tactical air strike forecasts.[2]

System Description: EVIS can be used to generate and deliver data and products providing the expected environmental effects on operations and is particularly suited to support the generation of products for new and evolving missions, such as maritime intercept and vessel boarding. Through a suite of web services, EVIS can generate summaries of environmental impacts and related images that are available and advertised through an enterprise. The EVIS capability enables a qualified meteorology and oceanography (METOC) domain expert to access high-resolution METOC information from a remote server, create tailored products for mission planning, and do this faster than is possible with the current tools available. Mission impacts are based on threshold rules that have been gathered from METOC handbooks and other authoritative sources, which define the allowable ranges for particular environmental parameters that impact military operations. The EVIS product provides a color-coded spreadsheet or matrix, listing the mission parameters and the environmental impacts for each forecast time. Each cell in the matrix is hyperlinked to a graphic product that represents the same time period and threshold environmental parameter (see Fig. 1). The geographic product is a shaded contour plot that shows a yellow shaded area where the selected environmental parameter is expected to cause a marginal impact on military operations, and a red shaded area where the impact is expected to be severe. Products are hosted and saved on the EVIS server and can be accessed securely across the

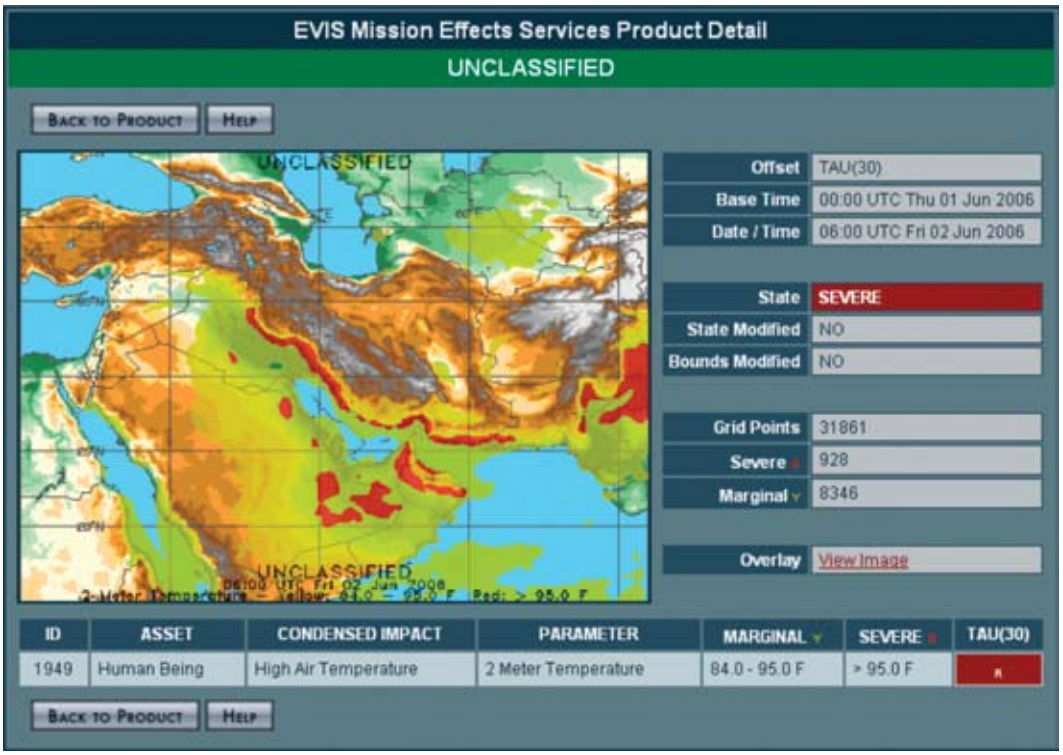

FIGURE 1
Graphical product generated in June 2006 showing the expected effect of high surface air temperature on personnel in the Middle East.

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
2008		**00-00-2008 to 00-00-2008**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Environmental Mission Impact Assessment	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Naval Research Laboratory,4555 Overlook Avenue SW,Washington,DC,20375**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**4**	

network via the Defense Information System Agency's (DISA) Federated Search service. The mission impacts can be generated for a general rectangular area, or generated for routes, route segments, and waypoints, and the thresholds for each rule can be modified by the user to meet their specific mission objectives.

Capabilities: With a service-oriented architecture design, EVIS capabilities can be orchestrated into workflows for different types of users and systems. While several orchestrations were developed and tested (both by the EVIS team and by others who had access to the EVIS service endpoints), the orchestration for FNMOC's operational capability supports two types of users—the expert forecaster who needs to produce and post environmental effects products quickly, and the operational user who needs to understand the forecasted effect on their planned or executing missions. The services that are available (see Fig. 2) include

- delivering metadata on the environmental data that is available for analysis;
- delivering analysis (including stoplight summaries, overlay map images, and data) of the expected effects on missions;
- searching through posted products for specific effects, using search parameters for the specific time, area, mission, and impacts;
- controlling access to services and data using attributes such as citizenship and clearance; and
- establishing secure connections to servers, services, applications, and clients.

The EVIS system includes the following data-oriented capabilities:

- XML metadata describing the availability of METOC data in a specified geographic region for specified forecast times;
- raw space/time METOC product data;
- METOC mission effects in XML format produced by analyzing the raw data using threshold rules;
- search services that respond to queries (formatted according to DISA's Federated Search specifi-

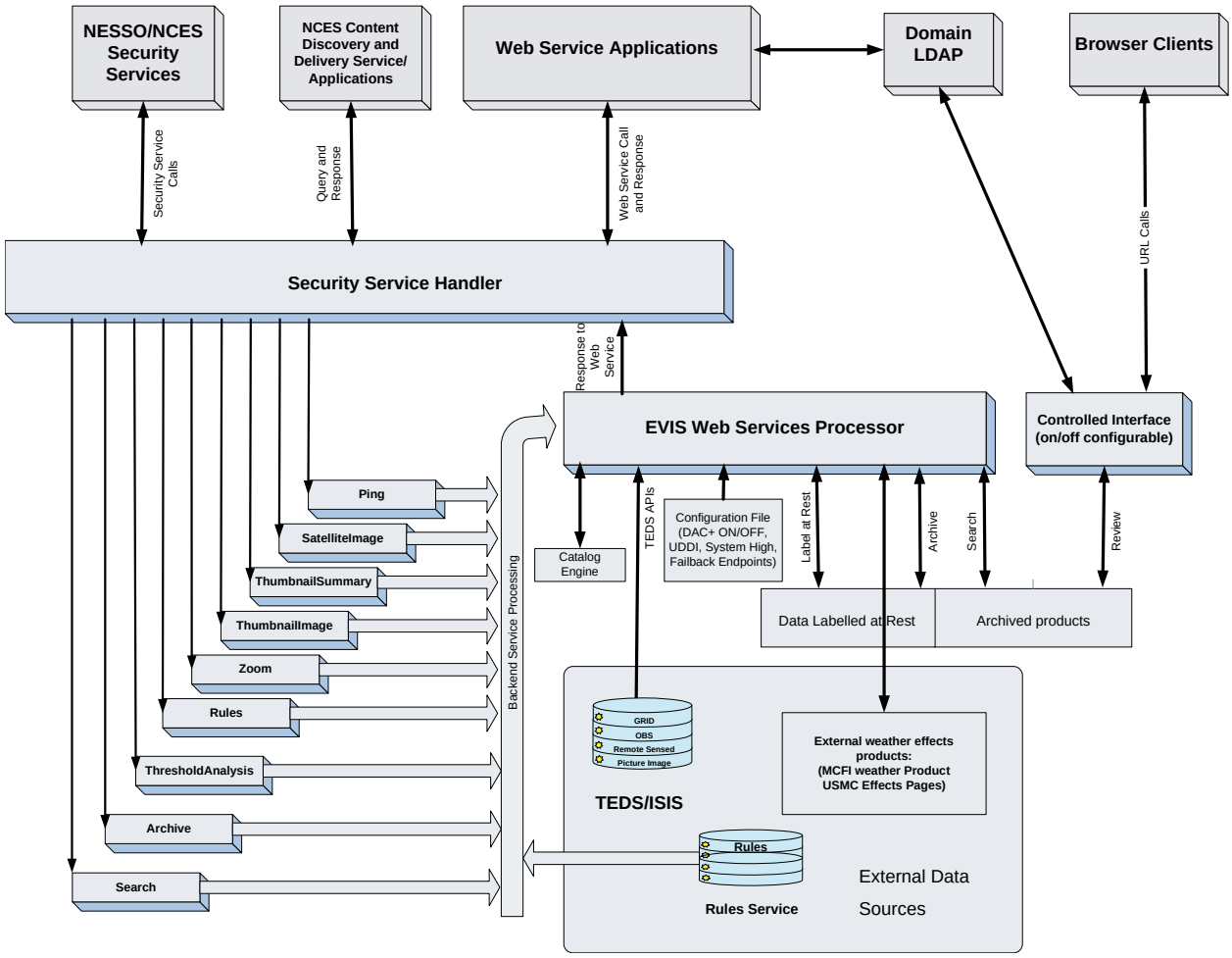

FIGURE 2
EVIS service-oriented architecture design, illustrating the interfaces to DISA's Net-Centric Enterprise Services (NCES) Security Services and Content Discovery and Delivery Service.

cation) by searching metadata files and returning results to the search engine; and

- staging of metadata about operational effects products including those produced by users of EVIS as well as products generated using other processes.

The user-oriented capability includes a portlet application available from FNMOC that orchestrates the EVIS services for authenticated users through a workflow process to define, request, and edit mission effects analyses (see Fig. 3). This capability takes tactical forecasting from a process involving meteorological and oceanographic cognition into one that includes aspects of tactical decision making. Although mission impacts can be produced through the formal application of threshold rules to environmental data, go/no-go decisions have much in common with statistical decisions because the underlying phenomena to which the thresholds are applied have statistical variability. Therefore, in practice, the forecaster has to have flexibility in

FIGURE 3
EVIS workflow showing views that a forecaster goes through to produce a product. The forecaster selects the classification of the product, model data to be used, area and route to be analyzed, the forecast times to be analyzed, and the rules to apply. The last three views illustrate reviewing the result and its details, and posting the product for dissemination and search.

applying the rules and be able to use knowledge about the details of the mission and the systems/personnel executing the mission. The EVIS portlet workflow supports the flexible tactical decision-making aspects of environmental mission analysis by providing

- forecaster control in selecting the METOC data source, the mission(s), the area of interest (AOI), routes and waypoints, forecast times, and analysis rules;
- a flexible method of generating new rules and editing these rules and setting the mission-relevant thresholds as needed;
- a graphical summary of the environmental data that falls above the threshold limits as well as hyperlinks to the raw data anywhere in the AOI; and
- a method of easily editing the computer-generated product before it is posted.

Summary: FNMOC is currently applying EVIS in support of DoD operations and exercises and making products and related data available and advertised for discovery by users on the Global Information Grid (GIG). FNMOC is now developing extensions to EVIS that incorporate environmental effects rules from a multi-service database and interfaces to additional environmental data sources.

[Sponsored by ONR and OSD]

References

[1] D.W. Jones et al., "Environmental Visualization and Horizontal Fusion," in *Proceedings of the Battlespace Atmospheric and Cloud Impacts on Military Operations (BACIMO) Conference*, October 12–14, Monterey, CA (2005).

[2] J.A. Ballas et al., "Improved Workflow, Environmental Effects Analysis and User Control for Tactical Weather Forecasting," in *Proceedings of the Human Factors and Ergonomics Society 48th Annual Meeting*, September 20–24, 2004, New Orleans, LA (2004).